THE SNAKES OF DEOLALI.

With Notes on their comparative Osteology and peculiarities of Dentition.

BY

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Part I.

(*With* 2 *plates and* 2 *text-figures*).

Introduction.

This paper is the outcome of a study, which in its initial stages had been restricted to identification, with a view to listing the families and species appearing from time to time in this locality. For this purpose a collection was begun in Deolali. When the limits to the numbers of the prevailing local species seemed to have been reached and no further fresh material was forthcoming, the study was amplified so as to include the more important features connected with the differences in the osteology and dentition of those members of the sub-order *Ophidia* met with in Deolali.

The work undertaken has occupied the greater part of the author's leisure period for a little over two years. The results have amply repaid the time and labour involved and the study itself has afforded much instruction and entertainment. It is thought that the data collected and now presented may serve some useful purpose by their publication; as the subject is one in which, but few are seriously interested. Further the existing literature available on the points of osteology and dentition is scarce—some of the publications having been long out of print—and hence so costly as to put them beyond the reach of many, who perhaps would become interested were they able to procure such books for reference. Again the necessity for surveys of this kind need hardly be emphasised, as they not only furnish a more intimate and permanent record, but add considerably to our knowledge of the distribution of the various species.

The subject has been approached from the view-point of an interested student and amateur field worker. By combining the study of such authoritative publications as have been available along with the first-hand information found in the field, the writer has endeavoured to gather as many practical data as possible about those animals.

For the better comprehension of the text of this paper, it was considered advisable to support it with many illustrations. No apology is necessary for their profuseness, as without these aids it would not be possible for the reader to readily follow and appreciate the morphological characters and more especially the divergent features existing and helping toward separating out the

families, genera, and species. Great care has been exercised in the correct delineation of the peculiarities both in the case of the skulls and vertebrae, by enlarged scale drawings in black and white, featuring all the details in the original bones. These, again, have been photographically reproduced so as to make the final pictures look quite natural.

This paper will deal with a total 22 species belonging to four families, which have so far been investigated on the points of external characters. The osteology and dentition of 20 of these have been dealt with and will be found described in the notes which follow. For purposes of comparison 2 species extraneous to Deolali have been included in the total shown above. Of these, one is from Bengal and the other from Mahableshwar (Deccan). The latter one was imported into Deolali under peculiar circumstances and will be referred to again later.

A table has been compiled showing the cranial and vertebral column measurements of the species described. This table also shows the ratio of growth occurring in skeletons of specimens of varying length and ages. As regards the vertebral column, it has been found possible to group the snakes according to the differences noted in the formation of their vertebrae. This vertebral grouping is of great interest, and the table of variations depicts the natural series into which they fall.

The literature which has been studied will be fully quoted at the end of this paper, but special mention must be made of three valuable publications from which great help was derived:—(1) *A Catalogue of Snakes in the British Museum*, by Dr. G. A. Boulenger (1893-6), vols. i, ii and iii; (2) *The Thanatophidia of India*, by Col. F. Fayrer (1872); and (3) *Animaux venimeux et Venins*, by Mme M. Phisalix (1922), tome ii. The first of these was perused at the Bombay Natural History Society library rooms, Bombay, in an incomplete way during the brief respite of a few hours while on a short visit to that city. The two latter were made available for study through the kindness and courtesy of Mr. S. H. Prater, Curator of the Bombay Natural History Society, to whom the author is indebted for the privilege. The book *How to identify the Snakes of India*, by Col. F. Wall, C.M.G., I.M.S., has been found particularly useful and a very excellent practical guide to the identifications of snakes from their scale formation. The synopses and keys furnished therein are reliable aids to students, especially for those who have not the time for the labour involved in reducing to skeletons the specimens they wish to differentiate in a complete way.

Geographical Location, Meteorology and Physical Features of the Station.

Devlali or Deolali, the latter name is more popularly used, is a small Military Cantonment in the Nasik Civil Collectorate of the Bombay Presidency.

The height above the mean sea level is from 1,800 to 2,300 ft. The average rainfall is 30 in. The monsoon months are June,

July, August and part of September. The hottest months of the year are March, April and May, with the maximum shade temperature fluctuating between 100 and 110°F. The coldest months are December and January, when the minimum shade readings vary between 44 and 60°F.; the average mean being about 85°F. Dry and Wet bulb registrations show a marked humidity during October.

The topography of the country in the environs is undulating in character. On the south side lie the Thal Ghat extensions running east and west. The land is for the most part under cultivation, and is intersected by deep tributary 'Nallahs' draining into the river 'Darna', which meanders through east of the Cantonment in a north-easterly direction to a point some ten miles east of Nasik City, where at 'Darna Sangava' it joins the sacred river Godaveri.

In order to obtain precise data as to the Ophidia present, 195 specimens collected over a period from December 1932 to January 1935 were examined and revealed evidence of 4 families and 20 species in an area roughly comprised within a 5-mile radius from Devlali Railway Station (G. I. P. R.). In this area lie the villages of Bagoor, Wadner, Nanegaon, Vehitgaon, Sansari, Deolali, Shigwa and the Nasik Road sector.

Included in the previously quoted figures is a collection of 45 snakes kindly sent to me by Mr. Fenton-Bailie, House-Master, Barnes High School, Deolali. His collection contained of the known poisonous groups fatal to man, 2 Cobras, with several young ones, 4 Kraits, 5 Saw-scaled Vipers (*Phoorsa*), and 1 Russell's Viper. All of his specimens were gathered in over a period of several years in the precincts of the Barnes High School, which is within the area specified.

A second collection belonging to Rai Sahib A. G. Gokhale of the Government Distillery, Nasik Road, who very kindly accorded me facilities for viewing it, contained 1 additional species labelled *Polyodontophis collaris*. There was neither time nor opportunity for closely examining the basic characters of this specimen. The particular label affixed to it is at variance with the habitat cited by authoritative writers on the subject, who show the distribution as Himalayas, Bengal, Assam (Wall, F., 1923)[1]; Himalayas and Assam (Phisalix, M., 1922).[2] Rai Sahib Gokhale is himself uncertain as to its identity. The colour markings correspond with those of *Polyodontophis subpunctatus* and 1 specimen of this species had already been secured in Deolali. As the specimen had been in spirit apparently for a very long time, no reliance could be placed on the colour. This collection however is excluded from the numbers personally examined, and it is mentioned only to show that, with one doubtful exception, it agrees with the findings at Deolali.

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[1] *How to Identify the Snakes of India*, by Col. F. Wall, C.M.G., I.M.S., 1923.

[2] *Animaux venimeux et Venins*, by Mme. M. Phisalix, 1922, tome ii.

The listed series tabulated in this paper can be considered as fairly representative of the types met with in the area, but of course cannot be so comprehensively complete as to include the whole of the Nasik Civil Collectorate. The hilly tracts of the district possibly do harbour other species. If the Deolali findings are compared with those ascertained by Col. Gharpurey, I.M.S.,[1] to be in Ahmednagar, in the adjacent Collectorate, the list for that area shows 1 added species, namely, *Eryx johnii*, whereas *Polyodontophis subpunctatus* and *Dryophis mycterizans*, which are rare snakes here have not been encountered by Col. Gharpurey. Except for these differences the two lists are identical.

General Morphological Features.

As a preliminary to the systematic description of each snake, it is necessary for our purpose, to give a brief synopsis of the general Ophidian characters as also the peculiarities which help to separate out the families and species, terrestrial, arboreal and aquatic; and so serve for their identification and classification.

A. Common Characters.

(1) The endoskeleton is encased in a scaled exoskeleton, which is devoid of any appendicular parts.

(2) The bodies are all elongated, but vary in shape and size.

- (*a*) They may be of uniform rounded thickness throughout, built stoutly or slenderly without any delineation between the head and body or tail.
- (*b*) A slender neck demarcating the divisions between the head and body, both of which may be lightly built or massively formed.
- (*c*) Small heads connected by slim necks to bodies anteriorly thin, but posteriorly broadly built and equipped with flattened tails to facilitate progression through water.

(3) Tails of various kinds:—

- (*a*) Rounded, much abbreviated, dumpy and stout or thinning out abruptly.
- (*b*) Slightly compressed, much attenuated and fine (whip-like).
- (*c*) Flattened dorso-ventrally and adapted to act as paddles.
- (*d*) Equipped with rattles.

(4) Heads may be rounded, flat, ovate or triangular with or without loreal pits and horns.

(5) Muzzles acutely pointed, obtuse or squared.

(6) Nares placed laterally or superiorly behind the rostral (snout shield).

(7) Eyes covered with the antocular membrane, but lidless. Pupils, spherical or elliptical spindles placed in the vertical or horizontal positions.

(8) No external evidence of an auditory apparatus and no tympanic cavity.

(9) Tongue bifid and contractile.

(10) The flexibility and extensibility of the ribs, which in conjunction with the transverse plates or ventrals of the belly secure mobility and locomotion.

(11) The generative organ in the males is paired.

(12) The *Ophidia* are either oviparous, laying soft ovate eggs ordinarily hatched by the heat of the sun, or the warmth generated by fermentative processes set up in decaying vegetation; or ovo-viviparous, that is the eggs are incubated within the body and the young emerge alive and fitted for an independent existence.

(13) The red blood corpuscles are nucleated biconcave discs.

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[1] 'Snakes in Ahmednagar', by Lt.-Col. K. G. Gharpurey, I.M.S., *Journ., Bombay Nat. Hist. Soc.*, vol. xxxvi, No. 1, p. 272 (15th November, 1932).

B. Classification.

There are about 1,700 species of snakes in the world (Manson, 1921).[1] Their identification and classification into 9 main family groups and their further separation into sub-family divisions, genera and species is based upon a study of:—

(1) (*a*) Head shields or scutae. Their presence and arrangement or their absence.
(*b*) Loreal pits and horns on the head or their absence.
(2) The costal scales:—Their size, shape, arrangement and number.
(3) The ventral plates:—Their size, width and number; or their absence.
(4) Anal shield, whether entire, divided into two or further subdivided into three sections.
(5) Subcaudal plates, whether entire or divided throughout or only partially so.
(6) Mental sublingual shields, whether present in one pair alone, or in two or three pairs.
(7) Tails, whether rounded, slightly compressed or flattened dorso-ventrally.
(8) Colour. This is not an accurate guide as there are variations even in the same species.
(9) Design. The pattern of the markings are a more constant feature in the adults, but the young of certain species differ markedly from the adult.
(10) Rudimentary limbs. Concealed vestiges of hind limbs below and near to the cloaca, peculiar to the sub-family *Pythoninae*.

The foregoing are the external characters. Their accuracy is considered of questionable value in distinguishing species, because of the aberrant types frequently met with. The more important fundamental differentiations rest upon the formation of the skull; the shape, size and position of the maxilla; the absence or presence of certain bones in the skull and chiefly the peculiarities of the dentition, which most of all facilitate the separation of the *Thanatophidia* or poisonous snakes. The known poisonous species belong to either of two families, namely, *Colubridae* and *Viperidae*. These are recognised by the size, length and position of the maxilla, which in the former is long, thin and horizontally positioned and in the latter short, thick and obliquely set.

The world *Colubridae* number some 1,300 (Manson, 1921),[1] and form the largest family of the sub-order Ophidia. They are divisible into three groups according to the peculiarities of their dentition. The presence of large infolding canaliculated recurved fangs placed in the forward position attached to the maxilla, denote the class known as the *Proteroglypha* (front-fanged). If situated posteriorly as the last in the maxilla series of teeth and grooved on their anterior aspect as well as recurved, they belong to *Opisthoglypha* (back-fanged). The third group comprises species in which the teeth are all solid and which are classed as *Aglypha*. There are further distinctions in the sub-families *Elapinae* and *Hydrophinae*, and the species in these sub-divisions are distinguished by the nature and setting of the teeth in the various situations in the roof of the mouth and the mandibles.

The poison fangs proper attain formidable proportions in some of the *Thanatophidia* and are connected by ducts to specialised

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[1] *Manson's Tropical Diseases*, edited by P. H. Manson-Bahr, 1921, p. 874.

poison glands in the *Proteroglypha* and the *Viperidae*. In the latter the poison fangs are comparatively larger and better developed and attached to a vertically fixed maxilla. The poison of certain species in the first 2 families cited above, if injected in lethal doses, has been established as dangerous and fatal to man and the higher animals.

The *Opisthoglypha* possess a parotid gland, which secretes a toxin not definitely ascertained or known to be potentially fatal to the higher vertebrates. The *Aglypha* have solid teeth and homologous glandular structures secreting a venom, which, as in the *Opisthoglypha*, kills small mammals, birds, reptilia and amphibia.

The dentition in the case of the seven remaining families, namely, *Typhlopidae*, *Glauconiidae*, *Uropeltidae*, *Ilysiidae*, *Xenopeltidae*, *Boidae* and *Amblycephalidae* shows in some the presence of teeth in the premaxilla (intermaxillary), or the provision of a lesser number of teeth, or the absence of them in certain situations. All of the teeth in these are solid. These snakes do not assume the importance attached to those in the higher specialised categories mentioned, as they are believed to be innocuous; because the majority of them are possessed of small glandular structures in proportionately small heads and being devoid of grooved fangs can neither secrete enough venom nor inject it in a quantity great enough to act in a lethal way in man. There is actually no rigid division between the known poisonous snakes and other species. It can be accepted in a general way that all snakes are provided with some form of poison apparatus, variously graded and adapted to suit their needs for securing prey or for defensive or digestive purposes. The lethal and toxic effects of the venom from a number of species have been amply demonstrated in the laboratory by many investigators.

The *Viperidae* in the world number about 110 species (Manson, 1921)[1] and are divided into two sub-family groups, the *Viperinae* and the *Crotalinae*. The latter constitute the class which show a sensory uveal pit situated between the eye and the nostril. All of these are potentially venomous and certain species are known to be dangerous.

There are about 330 recognised species of snakes in India and Ceylon (F. Wall, 1928),[2] including the *Hydrophinae* or marine snakes characterised by their paddle-like tails. These number 29 species found in the Indian seas. They are all poisonous and the venom has been variously estimated by laboratory procedure to be of a higher potency than any of the terrestrial *Thanatophidia*, which number 39 (F. Wall, 1928).[2] As has been previously stated, these belong to either of the two families *Colubridae* and *Viperidae*. In Deolali 4 families and 20 species are represented; and it will be noted that some of the well known poisonous Indian species occur in the area.

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[1] *Manson's Tropical Diseases*, edited by P. H. Manson-Bahr, 1921, p. 874.

[2] *The Poisonous Terrestrial Snakes of our British Indian Dominions* (including Ceylon) *etc.*, by Col. F. Wall, I.M.S., K.H.S., C.M.Z.S., 1928, p. 5.

TABLE I.—LIST OF SNAKES FOUND IN DEOLALI

Family	Sub-Family	Species	Number examined		
			Mr. Fenton-Bailie's Collection		Total
Typhlopidæ ...		*Typhlops braminus* (Daud) Worm Snake .	9	1	10
Boidæ ...	Pythoninæ .	*Python molurus* (Linn.) Rock Snake... ...	2	...	2
Do.	Boinæ ...	*Eryx conicus* (Schn.) Red Earth Boa	9	1	10
Colubridæ (*Aglypha*) ...	Colubrinæ ..	*Nerodia piscator* (Schn.) Checquered Water Snake	9	2	11
Do. ...	Do. ...	*Rhabdophis stolatus* (Linn.) Buff striped Keel-back	2	2	4
Do. ..	Do. ...	*Polyodontophis subpunctatus* (Dum and Dibr.) Jerdon's Polyodont ...	1	...	1
Do. ...	Do. ...	*Macropisthodon plumbicolor* (Cantor) Green Keel-back or grass Snake	30	5	35
Do. ...	Do. ...	*Lycodon aulicus* (Linn.) Wolf Snake... ...	14	5	19
Do. ...	Do. ...	*Ptyas mucosus* (Linn.) Rat Snake	18	...	18
Do. ...	Do. ...	*Zamenis fasciolatus* (Shaw) Fasciolated Rat Snake	2	...	2
Do. ..	Do. ...	*Coluber helena* (Daud.) The Trinket Snake ...	3	1	4
Do. ...	Do. ...	*Oligodon arnensis* (Shaw.) The banded Kukri Snake	5	4	9
Do. ...	Do. ...	*Oligodon tæniolatus* (Jerd.) Variegated Kukri Snake.	6	5	11
(*Opisthoglypha*).	Dipsadinæ ...	*Dipsadomorphus trigonatus* (Schn.) The brown tree or cat Snake.	16	6	22
Do.	Do. ...	*Dryophis mycterizans* (Linn.) The green whip Snake	...	1	1
(*Proteroglypha*).	Elapinæ ...	*Bungarus cæruleus* (Schn.) The Common Krait	5	4	9
Do. ..	Do. ...	*Naia naia*, var *cæca* (Merr.) The Cobra ...	14	2	16
Do. ...	Do. ..	*Callophis trimaculatus* (Daud.) The Slender Coral Snake ...	3	...	3
Viperidæ ...	Viperidæ ..	*Vipera russelli* (Shaw.) Russell's Viper ...	1	1	2
Do. ...	Do. ..	*Echis carinata* (Schn.) The Saw Scaled Viper...	1	5	6
	SPECIES EXTRANEOUS TO DEOLALI				
Colubridæ (*Aglypha*) ...	Colubrinæ ...	*Polyodontophis collaris* (Bengal)	1	...	1
(*Opisthoglypha*).	Dipsadinæ ...	*Dipsadomorphus beddomei* (W. Ghats, Matheran) ...	1	...	1
		Total ...	152	45	197

Seasonal Appearance and Proportion of the Sexes.

The table on page 66 shows the numbers and species appearing during the period under survey by months. Of the number shown, 112 were dissected for the purpose of study connected with the organs, viscera, genital organs, bones, etc. The figures relative to the proportion of the sexes, as also the number of gravid females found have been included in the table.

As regards the proportion of the sexes, it will be seen in this table, compiled from notes carefully maintained throughout the period, that there is an extraordinary disparity recorded as between males and females. Thus taking the total figure of 112, the percentage for the males works out at 5·4 and the females 94·6; showing a ratio of roughly 1 male to every 17 females. It is, of course, much too early yet to form any opinion or draw any conclusion on these results, as much more data of a similar kind confirmatory of this apparent sex disproportion will be required before the position can be accepted as a true index. It would not be premature though if one were to analyse these figures by way of ascertaining the extent to which the known facts relative to the habits of these creatures fit in with the ratio of the sexes as now outlined in the table.

In an article which appeared in a previous issue of this *Journal*, Mr. Prater (April 1933)[1] reviews, on the sum total of the collected data available at present, the position connected with the association of the sexes. He quotes the many instances of partnerships between males and females limited to a period which he calls the breeding season. Owing to the insufficiency of the existing evidence this breeding season cannot be defined clearly for any one species. In certain cases the companionship was continued after actual union had taken place and was even extended till the deposition of the eggs or young. Converse proof as well is cited and emphasised, that in all the instances of the many solitary females discovered near to or upon their eggs, only in two cases, a King Cobra and a Python, was the male observed in the close vicinity.

In the survey at Deolali there was only one instance of an association, which must have temporarily existed for the purpose of sexual union, in the case of *Zamenis fasciolatus*. A gravid female was killed in a garage at about 6 p.m. on 17th January, 1935. Exactly a week later during the evening in the same garage a second snake was seen to emerge from a hole in the wall and was later killed. It proved to be a male of this species.

All the gravid females including the above-quoted specimen showed the eggs in an early state of development, having soft oval membranous envelopes containing only a creamy fluid. These pregnant females—8 in number, and belonging to various species—were recovered as will be noted at different times of the survey periods. The months in which they appeared fall into two

[1] 'The Social Life of Snakes', by S. H. Prater, M.L.C., C.M.Z.S., *Journ., Bombay Nat. Hist. Soc.*, vol. xxxvi, No. 2, p. 469 (15th April, 1933).

Table II.—Seasonal Incidence and Proportion of the Sexes

Species	January	February	March	April	May	June	July	August	September	October	November	December	Total	Sex		Gravid Female	Remarks
														Male	Female		
Typhlops braminus ...	...	...	...	...	1	5	1	...	...	1 y	..	1	9	...	...	...	y :--Very young specimens 3″-6″ long.
Python molurus	1	...	...	...	...	...	...	...	...	...	...	1	2	...	...	...	
Eryx conicus	...	...	2 y	1	2	2	2 y	...	...	...	...	...	9	...	6	...	y :—Total—2.
Nerodia piscator	2 ♀	...	...	1	...	2	...	3	1	...	...	...	9	...	8	2 ♀	
Rhabdophis stolatus ...	...	...	...	...	...	1	1	...	...	...	...	...	2	...	2	...	
Polyodontophis subpunctatus. ...		1	...	...	...	...	...	...	...	...	...	...	1	...	...	...	
Macropisthodon plumbicolor.	5 ♀	2	...	2 y♂	5 y	7 y	2 ♂	2	...	2	...	3 ♀	30	2 ♂	24	2 ♀	y :—2 in May, Total :—4.
Lycodon aulicus	2	1	...	...	2	3	2 y	2	1	...	..	1	14	...	12	...	y :—Total—1.
Ptyas mucosus	...	1	1	...	5	5 ♀	3	1	...	1	...	1	18	...	15	1 ♀	
Zamenis fasciolatus ...	2 ♀♂	...	...	...	...	...	...	...	...	...	...	...	2	1 ♂	1	1 ♀	
Coluber helena	...	...	...	...	...	2 ♀	...	...	1	...	...	...	3	...	2	1 ♀	
Oligodon arnensis ...	...	...	...	...	3	...	2	...	...	...	...	...	5	...	2	...	
O. tæniolatus	...	...	...	...	1	2 y	3 y	...	...	...	...	...	6	...	3	...	y :—Total—2.
Dipsadomorphus trigonatus...	1	...	...	...	5	3 ♂	4 ♀	...	1	1 y	...	1 ♂	16	2 ♂	12	1 ♀	y :—Total—1.
Dryophis mycterizans ...	...	1	...	...	...	...	...	...	...	...	...	...	1	...	1	...	
Bungarus cæruleus ...	1	...	...	...	...	...	1	...	1	2	...	...	5	...	3	...	
Naia tripudians	1	...	1	...	1	4 ♂	3 y	...	2	1	...	1	14	1 ♂	11	...	y :—Total—1, 7″ long.
Callophis trimaculatus ...	...	1	1	...	...	...	1	...	...	...	...	...	3	...	2	...	
Vipera russelli	...	...	1	...	...	...	...	...	...	...	...	...	1	...	1	...	
Echis carinata	1	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	
Total ...	16	7	6	4	25	36	25	8	7	8	...	9	151	6	106	8	

separate periods, December-January and June and July. Whether these two periods can be considered and defined as regular breeding seasons is very difficult to decide at the moment. The finding in two species of the young 2 to 5 months subsequent to the months during which the gravid females were encountered is consistent and would roughly indicate the interval necessary for the fertilisation, deposition and incubation of the eggs.

In the analogous examples of pairing during the breeding season amongst the Passerine birds and certain animals, one finds the sexes more or less equally distributed at least in a proportion, which would allow of the majority finding mates and forming a monogamous partnership in the sense of a seasonal continuity somewhat extended to cover sexual union, deposition of the eggs, incubation and care of the young until fledged, as is the case with many species. This form of companionship is well exemplified amongst the groups in which parental care is a paramount development and its exercise essential for the well-being and survival of the young. In the case of the snakes, however, we find an absence of parental anxiety—such indications as there are point to a scant attention paid to the eggs alone, rather than toward the young, which significantly enough emerge from the egg in a state perfectly fitted for an independent existence. Coupled with this is the evidence, that these creatures appear to lead isolated lives, in that they are normally seldom encountered in pairs. Environmental factors such as an extreme temperature in the very cold parts of the world operate in driving them into the gregarious congregations composed of the small hibernating groups in which they have sometimes been found.

The question now arises as to what are the justifications for postulating that the disproportion in the sexes supports and explains the observed habits and behaviour. A study of the detailed figures in the table shows that in certain species the number of egg-bound females recovered equals the number of the males found separately at the same time. Further, in all the species involved there is a variation in the sex proportion. The ratio in these is as under.

Species	Males	Females	Males	Females
Macropisthodon plumbicolor ...	2	24	1	12
Zamenis fasciolatus	1	1	1	1
Dipsadomorphus trigonatus ...	2	12	1	6
Nāia tripudians	1	11	1	11
			4	30
		or approximately ...	1	7 or 8

This average ratio of 1:8 may probably represent in a general way the actual relative proportion existing between the sexes of the above species. Both this ratio and the equal number of males and gravid females simultaneously discovered during the two periods apparent in Table II would explain:—(1) Why they

are not more frequently observed in pairs. (2) That the variations in their behaviour connected with the partnerships affected, which appear in some to be of a temporary nature confined to the period incidental to insemination and in others somewhat more extended until the deposition of the eggs or young, would suggest that environmental conditions (*a*) in the former, militate against a long association in areas more controlled and inhabited by man, wherein certain species find the food and other values more conducive and beneficial in the struggle for existence; (*b*) in the latter, allowing of the development of a form of parental care confined to the eggs, peculiar to the larger species like the Python and King Cobra, which occupy lone wastes and jungle tracts more free from human intrusion and interference or other detrimental factors. (3) That an excess of females would balance the scales in favour of both the propagation and survival of the species in situations where unfavourable conditions especially attributable to human enmity produce a high death rate amongst them. (4) That amongst the dominant species in any one locality the females would normally show an increasing geometrical ratio; this position would also account for the fact that they are more often seen singly.

A further study of the figures in the table shows two phases of numerical increase. The first occurring during the months of May, June and July, when the greatest numbers were recovered. May is the hottest month of the year in Deolali and the monsoon is ushered in about the first or second week in June, becoming well established thereafter and during July. The figures for these months are really a measure point or mode, which would probably also indicate the factorial values of the environment, wherein at this season the conditions are best suited to the animal, namely, (1) temperature, (2) luxuriant vegetation and tall grasses affording easy surface concealment, (3) a plentiful food supply, (4) comparatively less human interference owing to the heavy rains. Paradoxically enough the figures for these months actually feature the highest mortality incidence. A death rate in any colony of animals is considered to be selective in action with a view to the elimination of the unfits. The greatest check to increases in the snake population is the hand of man. The mortality rate here shown was practically confined to those, who most exhibited an adventurous spirit, by prematurely emerging from their hiding places, either at too early an hour in the evening, or persisted in remaining exposed and visible during the early morning and forenoon, and in a few isolated instances even during the afternoons of a cloudy day. In fact this diurnal activity of a purely nocturnal animal is mainly responsible for 90 per cent of the death rate in the total number recovered throughout the period. Sunless monsoon days and a living food supply plentifully available at this season acted as the lure drawing them unwittingly to the gamble with their lives as the stake. The adage 'Be as wise as the serpent, etc.' here appears worn into a platitude. It should reasonably read: 'Even the wise serpent has much to learn'. The second phase of numerical increase though to a much lesser and

negligible extent occurred in December and January. Both these periods correspond with the seasons during which the gravid females were encountered. Furthermore it is singular to note that the appearance of the males synchronised with the periods, with, but a single exception, during April, in the case of *Macropisthodon plumbicolor*. This species happens to be the dominant type in Deolali.

There is therefore some reason for believing that the sex disparity noted is probably the true position, as it tends to support and explain the relations and pertinent behaviour of these reptiles.

The consideration arises in the case of snakes as to what actually constitutes a breeding season. As has been shown the data hitherto collected are very indefinite and insufficient to allow of any definable limits being assigned. The term breeding season as used in the case of birds is known to be a definite period recurring in a regular annual cycle, sometimes in certain species twice yearly. It is said to be aroused as a result of some external or rhythmic stimulus (H. Whistler, 1932).[1] If this principle be applied to the *Ophidia* then normally we would expect to find them more constantly and frequently in pairs. We have seen that the evidence on this point is very meagre. The findings at Deolali are similarly inconclusive in that only one example of an association of the sexes can be reasonably presumed to have existed—that is only one case of pairing in a total of 151 snakes. Mr. Prater (April 1933)[2] observes:—'The finding of a male snake with a gravid female does not imply that the male so discovered is the one responsible for the gravid condition of the female'. In the instance quoted above the pair belonging to the species *Zamenis fasciolatus* were the only two of this kind met with in the two years of observation at Deolali and localised to one particular spot in a garage. So that the presumption that the male was responsible for the gravid female and must have been in a direct association is fairly valid and logical. The finding on the other hand of egg-bound females without the male makes the position somewhat difficult especially in the matter of defining the limits of a breeding season. The figures for Deolali shown in the table suggest two such periods provided the recovery of unpaired egg-bound females and unpaired males belonging to the same species be the basis for such definition. When, however, the Deolali figures as to the gravid females are compared with those of Mr. Lindberg (February 1932)[3] covering a similar range of species in the Barsi Light Railway sector, a variation in the species *Macropisthodon plumbicolor* becomes evident, in that gravid females were recovered during December and January at Deolali and March, April and May in the Barsi Light Railway area. That they were absent in Deolali during the months they were met with in the

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[1] 'The Study of Indian Birds', by H. Whistler, F.Z.S., M.B.O.U., Part IX, *Journ., Bombay Nat. Hist. Soc.*, vol. xxxv, No. 3 (15th February, 1932).

[2] 'The Social Life of Snakes', by S. H. Prater, M.L.C., C.M.Z.S., *Journ., Bombay Nat. Hist. Soc.*, vol. xxxvi, No. 2, p. 473 (15th April, 1933).

[3] 'Snakes on the Barsi Light Railway (Deccan)', by K. Lindberg, *Journ., Bombay Nat. Hist. Soc.*, vol. xxxv, No. 3, p. 690 (15th February, 1932).

other area does not preclude the possibility of such being found at some future time in the reversed positions in both localities—not only in this species, but as a common constant feature in other species as well. Nor can it be said that the seasonal variability in their appearance is attributable to the meteorological conditions varying in the different geographical settings.

The conjoint results nevertheless demonstrate well enough the small amount of evidence forthcoming despite the two years' observations in both places. This question of the breeding season and the apparent variable character of the periods amongst the different species, requires concentrated and extended observations covering many years, in as many areas as possible. The comparative excerpt relative to the recovery of gravid females both in Deolali and the Barsi Light Railway sector is as under—unfortunately Mr. Lindberg does not show the actual figures for the egg-bound females and makes no mention whatever of males. The numbers met with in Deolali have been shown with a plus sign and the numerical indicator alongside. Those of the other area by a plus sign alone.

Species	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Nerodia piscator... ...	+2	...	...	...	...	...	...	...	...	...	...	...
Macropisthodon plumbicolor.	+1	...	+	+	+	...	...	...	...	...	...	+1
Ptyas mucosus	...	...	...	...	+	+1	...	...	...	...	...	...
Zamenis fasciolatus ...	+1	...	...	...	...	...	...	..	...	...	...	...
Dipsadomorphus trigonatus.		...	...	...	+	+	+ +1	...	...	...	...	...
Coluber helena	...	...	...	...	...	+1	+	...	...	...	...	...

To sum up the position we find:—

(1) Sex disparity—1 male roughly to every 8 females;

(2) Pairing infrequent—one pair in a total of 151 snakes;

(3) Solitary males and gravid females of the same species found at identical times and in almost equal numbers in the same area;

(4) Finding of young 3 to 6 in. long, two to five months subsequent to the appearance of gravid females of the same species—furnishing evidence as to the probable interval required for the fertilisation and incubation of the eggs.

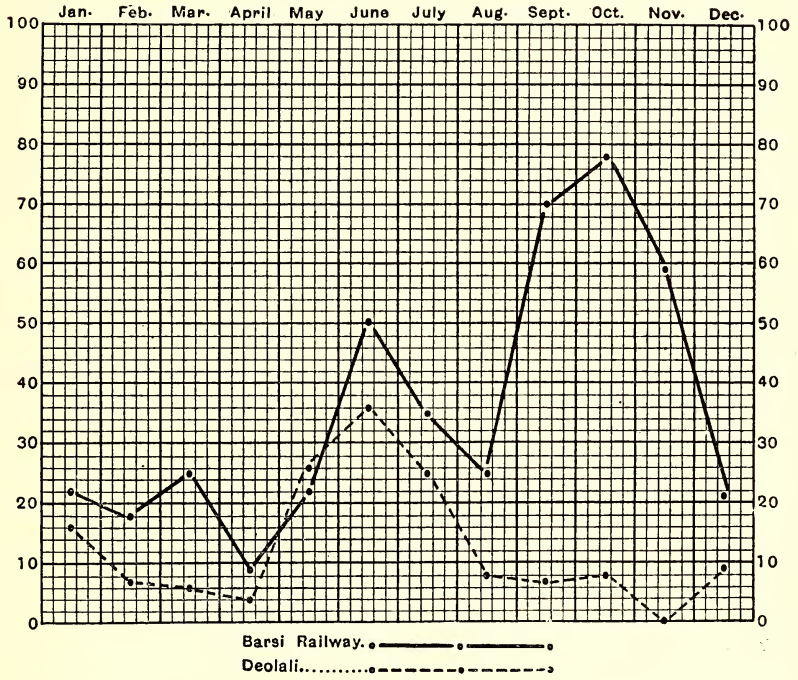
Periodic Numerical Fluctuations as a result of Seasonal Changes in Different Geographical Areas.

Precise information as to the periodic appearance or absence of snakes in the various geographical areas is lamentably scanty, despite the fact that thousands of these creatures are being killed annually. Mr. Lindberg (February 1932)[1] in his contribution has

[1] 'Snakes on the Barsi Light Railway (Deccan)', by K. Lindberg, *Journ., Bombay Nat. Hist. Soc.*, vol. xxxv, No. 3, p. 690 (15th February 1932).

made a good beginning and the figures he furnishes for the Barsi Light Railway area allow of a comparison being made with those recorded for Deolali. This is well outlined in the graph as under, based on observations made from December 1932 to January 1935 at Deolali, and from August 19, 1929, to August 18, 1931, in the Barsi Light Railway tract, on a total of 151 and 434 snakes respectively.

Graph showing periodic numerical fluctuations as a result of seasonal changes influencing the appearance and activity of snakes in the different geographical settings of Deolali and the Barsi Light Railway Areas.



The graph shows two peaks—one in June and another, the highest, in October for the snakes on the Barsi Light Railway area. In Deolali there is only one peak during June. There is a notable absence of snakes in Deolali during November. In contrast with this the maximum numerical peak is attained during September, October and November in the Barsi Railway sector. The decline in Deolali on the one hand and the rise in Barsi on the other, during the same period suggests evidence of the effects of environment. The climatic conditions evidently at that time being unfavourable in the one and beneficial in the other locality to practically the same species.

The complete absence of snakes in Deolali during November of the two years' period of observation is significant. About the

2nd November the cold weather is ushered in, and the change in temperature is somewhat acutely and abruptly established. It may be that the sudden drop in the temperature instinctively warns the creature and operates by keeping it temporarily confined, but not necessarily in a state of hibernation. This phase would probably represent the coincidental instinctive urge working in the expectation of a continued and increasingly severe cold setting in, like that experienced by their congeners in the very cold regions of the world, where as a result of prolonged subjection to a reduced and sustained temperature a complete torpidity or 'Winter sleep' is produced. As the minimum temperature at Deolali is at its lowest usually 44°F. and the diurnal range being great, the cold conditions here cannot induce in them, more than if at all a transient sluggishness, which passes quickly causing them to reappear in December. Further, it is noteworthy that the snakes did not disappear during the severe cold spell experienced in January 1935, when the minimum temperature fell to 31°F. and fluctuated at between 34° and 40°F. for about ten days. So rigorous was the cold that the fruit in the Nasik vineyards and orchards were greatly damaged by frost. Under these conditions of an extreme and sudden temperature reduction one would have expected not to find any increase in the numbers of snakes—yet 9 specimens were recovered during that month. Curiously enough their instincts on this occasion acted in an apposite direction and drove them out from their coverts into the warmth of the day. Certain living species which were kept in captivity at the time of the cold wave period did not go into hibernation nor was there the least sign of any torpidity in them. This may have been due to the fact that they were protected in boxes with a minimum of aeration.

Post-Mortem, Dietary and Other Findings in the Alimentary Canal.

It is a well-known fact that snakes can go for very long periods of time without a meal. There is the instance quoted by Mr. Prater (1926)[1] of a Python which refused food for ten months; and another in the Paris zoo which is said to have fasted for two and a half years. The writer himself kept and used as controls in some experiments, several living specimens of different species for eight months without food, giving them only water, without the least effect on their vitality. In the free state comparatively few are found with the alimentary canal containing evidence of an ingested meal. Of 112 specimens dissected, only 19 proved positive—approximately 17%. This suggests that the food factor does not loom very largely in their existence. Their specialised capacity for fasting tides over many long intervals of enforced starvation as during hibernation or other anxious occasions in their lifetime.

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[1] *The Snakes of Bombay Island and Salsette,* by S. H. Prater, C.M.Z.S., p. 3 (1926).

Cobra *N. naia* swallowing a frog.

Photo by *C. Diaz, Deolali.*

The following is the dietary findings as ascertained by post-mortem investigation:—

Species	Number Positive	Remarks
Nerodia piscator	3	Fish and frogs.
Ptyas mucosus	2	Rats and in one a lizard (species unknown).
Coluber helena	1	Rats.
Naia naia var. *cæca* ...	3	Rats and frogs and in one a Pipistrel bat.
Macropisthodon plumbicolor ...	3	Frogs.
Lycodon aulicus	2	Lizard (*Gecko*) and scorpion (*Buthus sp.*).
Dipsadomorphus trigonatus ...	3	Lizard (*Calotes versicolor*).
Eryx conicus	2	Palm squirrel.
Echis carinata	2	Earthy matter and rootlets.
Bungarus cæruleus ...	1	Earthy matter.
Typhlops braminus ...	1	,, ,,

A specimen of *Nerodia piscator* furnished an example of voracious feeding. The post-mortem revealed nine frogs and seven fish of varying sizes. The largest fish measured 3½ inches. Those which had reached the small intestine were partially digested. From below the throat backwards the alimentary canal was loaded with the fare. Unfortunately the photograph taken of the dissected snake with its victims laid alongside proved to be overexposed.

In one *Ptyas mucosus* a lizard was found—a striped variety, which is frequently here seen in the open country. The zoological classification of this lizard is not known to the author. The specimen has been sent to the Bombay Natural History Society for identification.

A Pipistrel bat was discovered in a cobra. This is a very unusual find and is particularly intriguing in view of the fact that the snake had been killed at 9-30 a.m. on the ground surface in the compound enclosure of a bungalow. One can, of course, only conjecture as to the how, when, and where of the circumstances, which caused the pipistrel to become a victim. It would be a reasonable surmise to say that the snake had secured the bat during daylight in the roof of the house, and cobras have sometimes been found in such situations; but on dissection the pipistrel was found in the alimentary canal in a position corresponding to the region of the hood. This fact would indicate that it had probably been swallowed some two or three hours previously. In the writer's experience, observations maintained in order to ascertain the time required for the complete digestion of frogs and lizards in the green keel-back (*Macropisthodon plumbicolor*) and the common cat-snake (*Dipsadomorphus trigonatus*) showed, that digestion is completed with no trace of even the victim's bones in approximately 72 hours. So that on this basis of calculation the pipistrel must have been seized in the early hours of the morning, either on its return to the roost in the eaves of the building, or at the ground level under

conditions of a handicap, which is very obscure and a futile speculation. Whatever the facts may have been it is nonetheless interesting to record this unique diet item in the menu fare of a cobra.

It may interest the reader to know how the time factor of 72 hours, estimated as required for a snake to completely digest a bolus, was arrived at. This was due to the accidental discovery, that red silk cord or thread is not subject to the action of the digestive juices secreted in the alimentary canal of the snake. It passes through quite unaffected. It came about in this way: For want of something better an attendant used a thin red silk cord slip knotted at one end to ensnare a medium-sized lizard (*Calotes versicolor*). Having secured it, he placed the lizard in a box containing a live *Dipsadomorphus trigonatus*. In doing this he cut the thread a short length from the slip knotted end which encircled the neck and dropped the lizard into the box. Some days later after the snake had feasted and digested the meal, the red silk cord was noticed lying in the box. The snake had obviously ejected it *via* the vent. The fortuitous omission to remove the red cord from the lizard in the first instance, led to many experiments being carried out in which the cord was used—not necessarily red, but the colour was convenient—tied to the legs of frogs and lizards and time records maintained from the moment they were swallowed until the cord had passed through the cloaca. This period in all cases worked out at 72 hours for the cord, but digestion must have been effected in a little under this timing.

Macropisthodon plumbicolor was found to feed solely on frogs, which appear in great numbers during the monsoon months. One of these snakes displayed in the matter of food a selective sense which is of interest. A male toad (*Bufo melanostictus*) was placed along with an adult specimen of this species. The toad appeared to realise the presence of the snake; as it showed during the first day very definite signs of fear. When at sundown the snake began to actively move about in the box, the toad exhibited great agitation and persisted in jumping at the intervening glass panel between it and freedom. If the snake approached too near, it quickly hopped away to a safe distance. On the second day the toad showed some composure, but behaved as on the first day if the snake at any time came near. On the third day surprisingly enough it evinced no dread whatever and was seen during the day calmly perched upon the coiled snake. On the night of that day the snake's activities did not in the least disturb its equanimity and it even allowed the snake to approach and pass it without leaping away. On the fourth day the toad showed signs of desiccation and did not appear too well and as the snake had shown no desire to swallow it, the toad was removed and placed in water. On the night of the fourth day a frog was secured and put in the box and significantly enough the snake at once seized it at the side of the neck and raising it clear off the floor held the frog firmly, while it squawked in terror—not all frogs make this sound, the majority are silent and stupidly inert when being swallowed. The snake maintained its hold for 12 minutes until the frog ceased

to struggle and while it was still alive and without having recourse to using the floor of the box, the snake veered the frog around by a gulping action until the head entered its mouth, when it began to swallow by alternating movements of the jaws. It then rubbed its neck by vigorous pushing movements along the floor of the box until the bolus had passed the cervical region. Plate I shows a cobra (*N. naia*) in the act of swallowing a frog.

A common Wolf Snake (*Lycodon aulicus*) was killed in the act of swallowing a scorpion. As the back of the snake had been broken it had ejected the scorpion when in its death throes. This information was given when the snake and the scorpion were separately brought. On examining the scorpion it was noticed that the maxillary palps, the chelicerae and the telson were missing. Dissection of the snake proved the alimentary canal to be empty. Further inquiry elicited no clue as to the missing parts of the scorpion, and an assurance was given that it had been brought as found. The snake when first observed was on the verandah of an Indian dwelling. How the parts of the scorpion came to be missing must remain a mystery.

In the writer's garden one night at 11 p.m. an interesting incident was brought into view by the flash of an electric torch which revealed but did not disturb either the snake—an adult *Dipsadomorphus trigonatus*, or the lizard—a small-sized *Calotes versicolor*. The lizard could not have been aware of the snake's approach. At the moment the light was flashed in their direction, the lizard was seen perched at the foot of a shrub and the snake was actually in the act of seizing its victim by a darting movement. It did so at the side of the lizard's neck and thereupon a desperate struggle ensued. Both snake and lizard rolled over on the ground; the lizard making frantic endeavours at escape and even dragging the snake along for a short distance. The snake then coiled itself around the lizard's body and prevented it from further progression and struggling. Presently a lull in the proceedings occurred, as the lizard now showed signs of exhaustion. It was breathing very heavily, but nevertheless still made futile and weakened efforts to free itself. After 16 minutes had elapsed the lizard commenced to sag and showed the onset of a moribund phase, depicted by a drooping of the head and closure of the eyelids. A further three minutes ushered in convulsions. The snake at this juncture released for the first time both its mouth and body hold and moved to the lizard's front. It then once more seized the head and while the lizard was still alive and breathing it commenced to swallow. This it did with a series of gulping movements, often seen in the farmyard when a chicken attempts to swallow too big a bolus of food—the forward and upward throwing of the head and short jerk back motion with distended jaws, tossing the lizard in the air to assist the effort. The jaws of the snake then moved alternately and independently to enable the teeth exerting a traction force backwards on the head and body with each fresh alignment taken. It occasionally rubbed the lower parts of the jaw and neck along the ground by way of aiding deglutition. When it had half swallowed the lizard the

snake was lifted up without signs of resentment and put into a box. The species of lizard mentioned above has been a constant find in the gut of this snake. Other observers have found chickens and eggs in this species.

In *Eryx conicus* the grey-striped squirrel (tree rat) was found. Mr. Lindberg (1932)[1] also mentions an instance of one of these snakes observed in the act of capturing a squirrel.

A point of interest noted in all the snakes, whether alive or dissected, was the outstanding fact that they swallow mammal, lizard, frog or fish, head first. This is an instinctive habit which mechanically facilitates the downward passage of the dead body which is ingested with the legs posteriorly deflected and folded in underneath. Muscular contractions of the ribs further aid lateral compression and propulsion backwards of the bolus. Were this not the case the dead lizard's spined dorsum and the clawed feet of frogs and mammals would be caught up and become impacted causing an obstruction in the alimentary canal.

In two specimens of *Echis carinata* the large intestines were astonishingly enough loaded with caked earthy matter in a half dry state and admixed with filamentous lengths of rootlets. Plate II depicts one of these snakes with its loaded bowel contents throwing the dark shadows of this substance. It is regretted that a sample was not retained for chemical analysis. X-Ray pictures of *Bungarus caeruleus* (Krait) and *Typhlops braminus* also show to a lesser extent earthy matter in the alimentary canal, both of which were confirmed by dissection. All of these snakes were free from any helminth infestation. This point is mentioned because in another snake, *Nerodia piscator*, the gut was crammed with a green and rather stiff water weed, which had become entangled with a mass of worms (nematodes), a few of which were alive and clinging to the stomach wall. Here the suggestion is strong that the weed had been swallowed on purpose as a curative measure in order to both dislodge the worms and kill them. The vermifugal and vermicidal action was certainly evident, because the majority of the worms were dead, judged by the discolouration of their bodies in contrast with the few living worms which were pinkish white and exhibiting movement. It was owing to these few still living forms being imbedded and attached to the stomach wall that the mass was held up in its backward motion in and through the alimentary canal.

The question of interest arising in the finding of earthy matter in the bowel of the snake is, whether earth-swallowing is also a habit with the snakes akin to that generally observed amongst other animals (salt licks)? The writer is unaware of a similar instance having been previously reported by other workers. Since the percentage works out at roughly 2 per 100 of the killed numbers in this survey, there is reason to believe that it is at times necessary for them to swallow earth in order to fulfil a physiological purpose.

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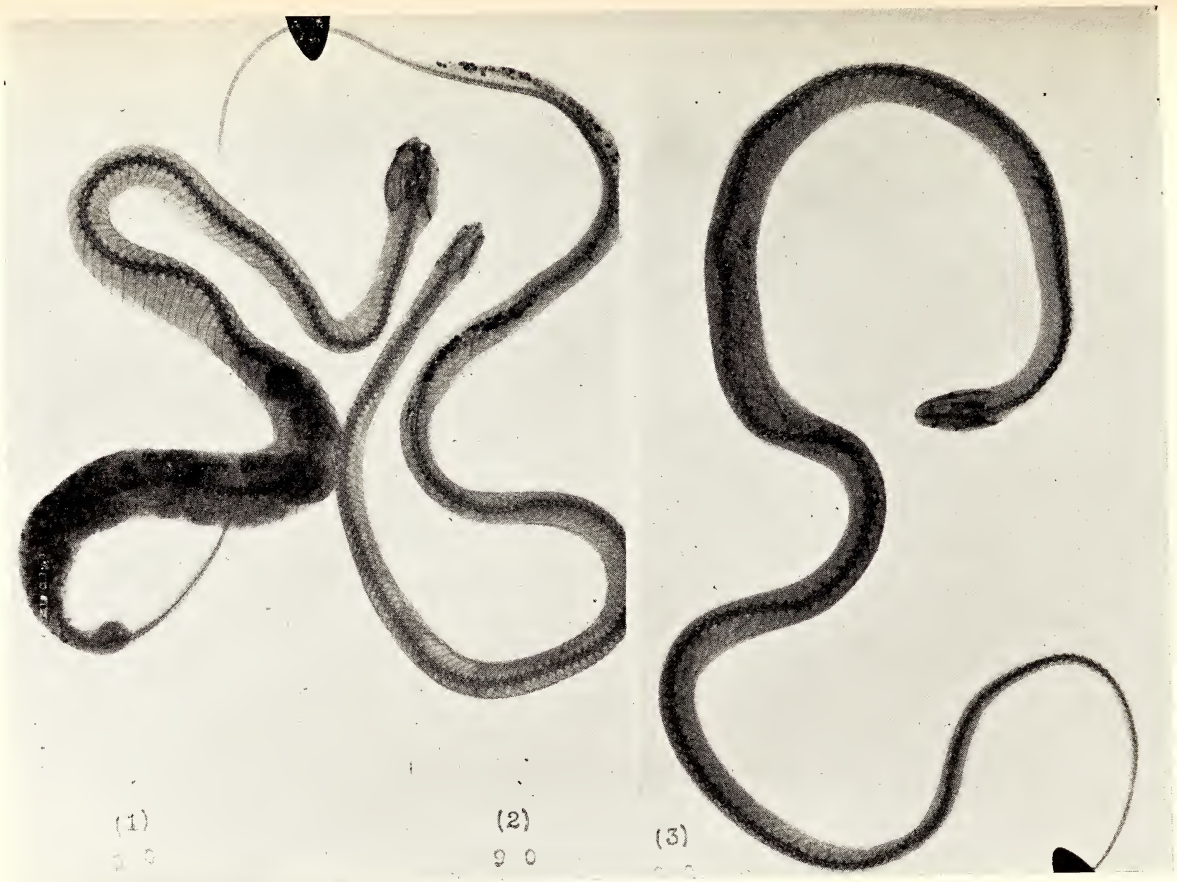
[1] 'Snakes on the Barsi Light Railway (Deccan)', by K. Lindberg, *Journ., Bombay Nat. Hist. Soc.*, vol. xxxv, No. 3, p. 690.



(1) *Echis carinata* (Schn.), The Saw Scaled Viper. Showing the lower bowels loaded with earthy matter.
(2) *Bungarus caeruleus* (Schn.), The Common Krait. Showing earthy matter in the lower bowels.
(3) *Rhabdophis stolatus* (Linn.), The Buff-striped Keelback. Showing the remains of an ingested meal—the bony outline of a lizard (?).

Radiograph by *C. P. Coshan, I.M.D.*

Cannibalism amongst snakes is a feature, which has been occasionally recorded. There were no examples of it noted at Deolali. The habit is evidently atavistic and confined to only a few.

About 12 per cent of the snakes dissected were infected with nematodes. It appears to be a disability in a general way common to most of the species. It must act as a considerable handicap, serving as a check to increase in their population. Those suffering from worms reject food. Several died early in one to two months of captivity. Post-mortem investigation revealed heavy infestations with worms in bunched masses occupying the stomach section of the alimentary canal.

Exfoliation.

The snake as is well known periodically throws off the epidermic investment. In order to ascertain the extent to which this is done and the manner in which it is brought about, a certain number of snakes were kept under observation for eight months. These were made into two series. One set from which the food was withheld, acted as controls for the other fed with such frogs, tadpoles and lizards as were procurable. All were watched and inspected as time and opportunity offered throughout the period. Receptacles containing water were kept replenished in their boxes, but were put in only from 18th April onwards. The number of times each snake in the respective series desquamated is shown as under: —

Species	Series No. 1 (fed).									Series No. 2 (Fasting control).								
	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Moults	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Moults.
Macropisthodon plumbicolor ...	.	...	...	1	1	2	1	...	5	1	...	...	...	...	1	...	...	2
Macropisthodon (*young*) ...	...	1	...	2	1	2	2	1	9	...	...	1	...	...	...	...	...	1
Nerodia piscator (*young*) ...	1	...	1	1	2	1	2	2	10	No control available.								
Lycodon aulicus.	...	...	1	...	1	...	...	...	2	..	1	...	...	...	...	...	...	1
Dipsadomorphus trigonatus ...	1	...	...	1	...	1	...	1	4	...	...	...	1	...	...	...	...	1
Oligodon tæniolatus ...	..	...	1	...	...	..	...	...	1	...	...	...	...	..	1	...	...	1

Desquamation occurred most often at night and was as a rule a complete cast. There are preliminary phases. For a day or two a change to a darker colour shade is noticeable. The outer layer of the epiderm is then seen to be slightly raised and wrinkled between each scale division. This roughening presents the appearance of a powdered surface owing to the whitening of the older exoskeleton.

The latter then loosens and lifts throughout the body length and as the caudal section is freed, the snake by opening its mouth widely several times releases the investments on the dorsal and ventral aspects of the head and by free movements over the ground surface crawls out of the detached cast. In some cases the epiderm becomes adherent in parts especially on the head. In such examples there is a general splitting of the covering, which then peels off in the course of a few days. During this time the snake is temporarily blinded unless the old antocular membrane becomes detached and is shed. Some snakes when afflicted in this way immerse themselves in water and get rid of the old skin.

The greater number of desquamations occurred amongst the fed series; apparently this must be a measure of the growth occurring as a result of the feeding. The control series probably reflect more truly the actuals taking place in the free state.

The following impressions were gained. The young specimens exhibited much greediness and fed voraciously, not as a regular daily feature, but at irregular intervals. The young water snake showed a perference for tadpoles and when these were available eschewed the frogs. It remained immersed in the water for most of the time. The adult specimens also fed irregularly and displayed the greatest activity at night; and when not feeding moved restlessly about looking for a means of egress. *Lycodon aulicus* fed sparingly, and it is doubtful whether *Oligodon taeniolatus* fed at all.

The Snake's Basking Habit considered in relation with Sun Traumatism produced in them as a result of direct exposure to the Sun's Rays.

The snake's basking habit has been frequently observed and recorded, more often as a marked feature peculiar to the vipers, and fresh water species. Whether it is general and indulged in by all snakes is not clear. The writer while on fishing excursions during the cold months of the year has often seen *Nerodia piscator* lying upon the river's bank exposed to the direct rays of an afternoon sun. As these snakes invariably returned to the water on one's approach it was found impracticable to time the period they remained so exposed. Snakes being poikilothermic or cold-blooded any prolonged exposure to the sun's rays must act adversely by disturbances set up in the metabolic balance and heat regulating centre, producing a sun traumatism resulting in death. As a matter of ecological interest, therefore, experiments were carried out by placing these creatures in the sunlight and estimating the time required for bringing about hyperpyrexia and death. For this purpose a bare patch of ground was selected free from any holes, away from trees and thus devoid of any shade. The snakes were allowed one at a time to roam freely over this area, but prevented from leaving it. It is greatly regretted that no solar radiation thermometer was available for those experiments; though the ordinary shade temperature readings have been